Observed and Estimated Total Bycatch of Salmon in the 2002-2004 West Coast Limited-Entry Trawl Fisheries for Groundfish

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Introduction

Trawl gear is the principal commercial gear type used to catch most groundfish species along the west coast. In 2004, trawlers landed 98% of all commercial groundfish tonnage, and 82% of all groundfish species other than Pacific hake. It is not uncommon for trawlers fishing on or near the continental shelf to inadvertently capture salmon while targeting groundfish. This report summarizes the bycatch of salmon species by limited-entry trawl vessels on trips that were observed during the calendar years, 2002, 2003, and 2004. Using the estimated amounts of salmon and groundfish catch on these trips, in conjunction with other fishery data, estimates of the total annual bycatch of salmon in the trawl fishery are developed for each of four geographic regions along the coast.

The West Coast Groundfish Observer Program (WCGOP) at the Northwest Fisheries Science Center began at-sea observation of vessels with limited-entry trawl permits in September, 2001. Under WCGOP protocols, vessels are selected for observer coverage using a stratified random sample design. Once selected, a vessel is observed during all of its fishing trips throughout a 2-month period, which coincides with the duration of most groundfish landing limits. Coast-wide coverage levels of the trawl fleet—as measured by the percentage of retained groundfish that was observed—have ranged from about 16% at the program's outset, to nearly 30% by 2004. (see Table 1, at http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport2005/Tables-TrawlReportJan2005.pdf). Coverage levels in the most active trawl ports have generally exceeded the coast-wide averages.

For trawl operations, total amounts of groundfish retained during a tow/trip, are recorded by an observer from the hailed weights recorded by the captain in the ship's logbook. These amounts are subsequently adjusted, so that species weights for a trip conform to amounts recorded in fish ticket (landing receipt) records. Generally, the number of salmon caught is ascertained through complete enumeration. However, where circumstances do not allow for complete sorting and enumeration of all salmon in a tow, the number may be estimated from partial samples

Methods

The summary of observed salmon bycatch includes all bottom-trawl tows by limited-entry trawl vessels that were observed between January, 2002 and December, 2004, with the exception of those where the amount of retained groundfish was less than the amount of other species retained. For each year, these data were stratified into four latitudinal regions, three depths zones and two seasons. The regions were defined as: U.S. waters north of Cape Falcon (~45.8^{o}), Cape Falcon to Cape Blanco (~42.8^{o}), Cape Blanco to Cape Mendocino (~40.5^{o}), and U.S. waters south of Cape Mendocino. The depth zones were defined by starting tow depths: shallower than 125 fm, between 125 and 250 fm, and deeper than 250 fm. Months from May through October were assigned to the Summer season, with remaining months designated as the Winter season. For each stratum, the numbers of salmon, by species, were summed, along with the weight of retained groundfish (not including hake). These data elements provide the basis for calculating bycatch ratios in the form of: the number of salmon divided by the weight of retained groundfish.

Estimation of the total bycatch of each salmon species involves four major steps. First, trawl logbook data for each year were summarized for two methods of stratification: the method described above (Stratification 1) and another utilizing year, state, and season (Stratification 2). Logbook entries lacking latitude-longitude coordinates or depths were not included. Within each stratum (both methods), the fish-ticket adjusted tonnage of all retained non-whiting groundfish species was summed.

Next, fish ticket data were used to calculate total groundfish landings, using Stratification 2. Ratios were then calculated by dividing each stratum's fish ticket tonnage by the corresponding logbook total. These expansion ratios were then applied to the logbook groundfish totals summed using Stratification 1. This adjustment process was needed to compensate for the fact that logbook data are not available for all trawl trips. Finally, the expanded logbook tonnage in each stratum was multiplied by the corresponding ratio of salmon-to-groundfish, from observer data, for each salmon species. This produced estimates of the total number of incidentally caught salmon for all strata.

Results

An overview of the annual numbers of salmon associated with observed trips in each of the four regions is provided in Table 1. Only a small percentage of the salmon captured by trawls were species other than chinook. In only one of the 12 year-region strata were more than 7 salmon species other than chinook attributed to observed trips. Chinook bycatch has tended to be concentrated in waters off Oregon. During 2002 and 2003, the area between Cape Falcon and Cape Blanco accounted for more of the bycatch of chinook on observed trips as the remainder of the coast combined. However, the amount of bycatch on observed trips in that region fell dramatically in 2004. Table 1 also reports the number of trawl tows that were observed in each region, along with the number and percentage in which salmon were encountered. North of Cape Mendocino, salmon were present in 4-9% of the observed tows. South of Cape Mendocino, fewer than 4% of the tows included salmon. As a measure

of effort, the amount of groundfish retained on observed trips is also summarized for each region.

A more detailed summary of chinook bycatch, including seasonal and depth dimensions, is reported in Table 2. North of Cape Mendocino, the ratios of chinook-to-groundfish reveal a strong seasonal pattern, with higher rates of bycatch occurring in winter months. With few exceptions, the chinook bycatch rates, within a region, are highest in the shallowest stratum (less than 125 fm). Throughout these three years, only 22 chinook were caught , coast-wide, on observed tows beginning deeper than 250 fm. In the two central regions during 2002-03, winter season bycatch rates inside 250 fm were the highest observed in any of the strata, ranging from 1.6 to 8.9 chinook per 1,000 lb of groundfish. In 2004, however, winter bycatch rates in these regions were less than 0.5 chinook per 1,000 lb of groundfish.

Tables 3 and 4 provide additional information regarding the distribution of chinook bycatch on observed tows. For the depth zones which account for most chinook bycatch (less than 250 fm), Table 3 reports the number of tows containing chinook and the percentage of those tows where only one chinook was caught. The percentage of tows with a single chinook is highly variable across regions, depths and years. However, in most strata, between 15% and 50% of tows with chinook had only one. Table 3 also summarizes the absolute and relative size of the largest single bycatch tow in each stratum. In six of the seven strata where more than 175 total chinook were caught on observed trips, at least 40% was attributable to the single largest tow. For each region and year, Table 4 summarizes the frequency distribution of observed tows, according to the number of chinook that were caught. During 2002, eleven tows contained at least 30 salmon each, accounting for more than 973 of the 1,754 chinook attributed to observed tows. In 2003, 1,793 of the 2,753 chinook estimated for observed tows were caught on the 23 tows that each had at least 30 chinook.

Results from the fleet-wide estimation of salmon bycatch are reported in Tables 5 and 6. Table 5 summarizes the estimated total number of salmon, by species, for each year, region, and season. In each of the four areas, the amount of chinook bycatch fell greatly between 2003 and 2004. The most dramatic reduction was observed in the region between Cape Falcon and Cape Blanco, where roughly 15,000 fish were estimated to have been caught in 2003, and fewer than 900 in 2004. North of Cape Blanco, the estimated bycatch of coho was 49 in 2002 and 71 in 2004, but zero in 2003. Conversely, south of Cape Blanco, 2003 was the only year of these three in which coho were observed in the catch of trawl vessels.

Table 6 provides a comparison of trends in the estimated bycatch of chinook and the amount of retained groundfish for the entire fleet in each region, season, and depth zone. In the shallow depth zone, there is a clear downward trend in retained groundfish in each region and season. During the Winter season, in all regions, the 2004 tonnage of retained groundfish caught in depths less than 125 fm was at least 70% lower than in 2002. During the Summer season, the minimum reduction in groundfish tonnage was 23%, with the regions north of Cape Mendocino averaging about 40% less groundfish in 2004. So, in addition to the presence of lower chinook bycatch rates in 2004, the reduction in trawling effort in near-shore waters also contributed greatly to the reduction in total estimated chinook bycatch between 2002-03 and 2004. In contrast, the amount of groundfish being retained from tows

occurring deeper than 125 fm has generally be stable or increasing over this three-year period. Consequently, reductions in estimated chinook bycatch in these depths have been driven primarily by lower bycatch rates. The shift of fishing effort from shallow to deeper fishing grounds is consistent with management efforts to encourage offshore fishing and reduce the potential for bycatch of shelf rockfish species that are being rebuilt.

Conclusions

Bycatch of salmon by the west coast groundfish trawl fleet is generally restricted to encounters with Chinook. The total coast-wide catch of other salmonids is estimated to be roughly 200 fish or fewer since 2002. The estimated coast-wide bycatch of Chinook was about 20,000 fish in 2002 and 2003, but fell by an order of magnitude in 2004. This decrease resulted from reductions in near-shore trawl effort, where salmon bycatch is usually highest, and more general reductions in the rate at which salmon have been caught, relative to groundfish.

Table 6.--Trends in limited-entry trawl amounts of retained groundfish and estimated chinook bycatch between 2002 and 2004, by area, season, and depth.

		< 125 fm						125.1-250 fm					
		Winter		Summer		All		Winter		Summer		All	
		retained ground-fish (mt)	est. num. of chinook	retained ground-fish (mt)	est. num. of chinook	retained ground-fish (mt)	est. num. of chinook	retained ground-fish (mt)	est. num. of chinook	retained ground-fish (mt)	est. num. of chinook	retained ground-fish (mt)	est. num. of chinook
North of Cape	2002	1,653	1,399	9,124	1,617	10,777	3,016	1,190	321	1,013	0	2,203	321
Falcon	2003	1,629	928	4,437	789	6,067	1,717	832	282	1,524	9	2,356	291
	2004	519	520	5,717	213	6,236	733	1,499	126	1,410	6	2,910	132
Cape Falcon -	2002	381	2,915	1,064	90	1,444	3,005	688	5,420	237	0	926	5,420
Cape Blanco	2003	596	11,697	968	39	1,564	11,736	920	3,271	913	11	1,834	3,282
	2004	18	16	612	557	630	573	899	285	1,130	0	2,029	285
Cape Blanco -	2002	372	2,972	1,027	1,620	1,399	4,592	553	3,175	273	0	826	3,175
Cape Mendocino	2003	248	1,089	311	360	559	1,450	357	1,541	795	0	1,153	1,541
	2004	26	114	612	24	637	138	380	261	570	0	950	261
South of Cape	2002	660	209	374	384	1,034	593	735	19	731	31	1,466	51
Mendocino	2003	305	78	492	157	797	234	576	0	479	0	1,056	0
	2004	149	48	290	15	438	63	460	6	821	0	1,281	6

		> 250 fm						All depths					
North of Cape	2002	1,130	24	294	0	1,424	24	3,973	1,744	10,431	1,617	14,404	3,361
Falcon	2003	999	0	891	0	1,890	0	3,460	1,210	6,853	798	10,313	2,008
	2004	1,387	7	345	0	1,732	7	3,425	653	7,473	219	10,898	871
Cape Falcon -	2002	898	0	303	0	1,202	0	1,967	8,335	1,605	90	3,571	8,425
Cape Blanco	2003	923	35	1,012	0	1,935	35	2,440	15,003	2,893	50	5,333	15,053
	2004	1,198	3	717	0	1,915	3	2,127	304	2,479	557	4,606	861
Cape Blanco -	2002	1,616	45	963	0	2,579	45	2,543	6,191	2,264	1,620	4,807	7,811
Cape Mendocino	2003	1,196	0	1,958	0	3,155	0	1,805	2,631	3,065	360	4,870	2,991
	2004	748	3	999	0	1,748	3	1,163	378	2,182	24	3,345	402
South of Cape	2002	1,275	0	1,866	0	3,141	0	2,670	228	2,971	415	5,641	644
Mendocino	2003	1,490	0	2,164	0	3,654	0	2,373	78	3,152	157	5,524	234
	2004	1,286	0	1,889	0	3,174	0	1,894	54	2,999	15	4,894	69

Note: the 'Winter' season is defined as the months January-April and November-December; 'Summer' is defined as May-October.